

Reform and Exploration of the Course System for Energy and Power Engineering Based on Engineering Education Professional Certification

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Abstract—In order to optimize the energy and power engineering curriculum system, This paper combines the training requirements of engineering education professional certification and the energy and power engineering education experience, according to the requirements of the engineering education certification standard curriculum, through the systematic exploration of the curriculum reform of various professional courses in the personnel training program, strengthen the students' The cultivation of professional comprehensive engineering quality and ability, Thereby achieving the goal of talent training, improving students' innovative practice ability and professional competitiveness, and improving the quality of talent training and social adaptability.

Keywords—engineering education, professional certification, Energy and power engineering, curriculum structure, Training mode

I. INTRODUCTION

In order to improve the quality of engineering education and adapt to the international engineering education professional certification trend. In May 2006, with reference to the practices of the members of the Washington Accord, China officially established the National Expert Committee for Engineering Education Accreditation [1,2].In June 2013, China was formally accepted as a preparatory member of the Washington Agreement. This is of great significance for improving the quality of engineering and technical personnel training, promoting the international mutual recognition of engineers' qualifications, and improving China's engineering technology field to cope with international competition. While China's higher engineering education has achieved rapid development, it also faces many problems and challenges [3].This paper combines the school's energy and power engineering professional school experience, through the professional training objectives, graduation requirements, curriculum system comprehensive analysis, according to the energy and power engineering professional certification standards, the professional curriculum system reform and optimization, to achieve talent Training objectives explore effective ways and means. [4,5]

II. THE MAIN PROBLEMS IN THE EXISTING PROFESSIONAL CURRICULUM SYSTEM

A. The curriculum system is set to "more standard".

Although the existing curriculum system is set up in accordance with the "Special Specification for Undergraduate Energy and Power Engineering of Colleges and Universities" prepared by the Energy and Power Engineering Teaching Steering Committee of the Ministry of Education of the Ministry of Education, However, the role and orientation of the curriculum system feedback in cultivating goals and cultivating graduates' abilities are not clear, and there is no curriculum system that corresponds to the training objectives and graduation requirements.

B. The curriculum system is set to be "less backward".

The existing curriculum system still mainly focuses on the setting and teaching of end problems such as traditional thermal engineering [6]. The curriculum has not yet deeply reflected the new educational concept in the professional development process. And the transformation trend of talent demand caused by the rapid development of energy power frontier technology industry. The chemical immersion method was used, the reagents used were of analytical purity, and the new process conditions were obtained by orthogonal test.

C. The curriculum system is set to "under-characteristics".

Although the existing curriculum system has already opened courses on the characteristics of the new energy industry. However, the content of these courses is also slightly "independent" and has not yet been truly integrated into the energy industry.

D. The curriculum system is set to "unemployed".

Although the existing curriculum system offers courses in engineering design and engineering technology, it still lacks the

professional ethics, law, economics and contracts required for the professional ethics and literacy of engineers.

III. CURRICULUM SYSTEM REFORM BASED ON ENGINEERING EDUCATION PROFESSIONAL CERTIFICATION STANDARD

In the process of starting the engineering education professional certification process, whether the curriculum system is scientific, reasonable and compliant directly affects the graduates' engineering practice ability and innovation ability, which in turn affects the professional training objectives and the accessibility of graduation requirements. The engineering education certification standard generally consists of eight indicators, namely, students, professional education goals, student outcomes, continuous improvement, curriculum system, teacher strength, teaching facilities, and school support. Among them, the curriculum of engineering education professional certification, in order to support the completion of graduation requirements, the curriculum system design has the participation of enterprises or industry experts. Therefore, colleges and universities have put forward the ideas, practices and experiences of the reform of various professional curriculum systems in response to the certification standards and requirements of engineering education. Our school's energy and power engineering majors analyze and research the engineering education professional certification of undergraduate colleges at home and abroad, and use the investigation and research on the professional certification and evaluation results of China in recent years to sort out the engineering education professional certification. In the curriculum setting requirements, through the optimization and integration of the curriculum system, the professional knowledge content is continuously updated, which is the main way to achieve the training goal of innovative talents in engineering quality education [7-10].

A. Top-level design

The construction of the curriculum system is an important part of the talent training model. In the process of formulating talent training programs, our school requires that we fully absorb the advanced educational concepts and methods of universities at home and abroad, especially the successful experience of the National Agreement on Education Certification in the Washington Agreement, and Outcomes-based Education (OBE). The concept, the scientific design curriculum system, combined with the social needs and the long-term development strategy of talents, has carried out the top-level design of the talent training objectives, training specifications, training process and training mode of each major. Through various reform measures, we will improve the quality of teaching and effectively enhance students' innovative spirit, entrepreneurial awareness and employment and entrepreneurship.

According to the status of the course in the cultivation of talents, a modular curriculum system is established to optimize the combination of courses. The course architecture is shown in Fig. 1. The engineering major requires that the total credits be controlled within 170 credits, of which the humanities and social science courses account for at least 15%, and at least 15% of the total credits of the engineering education professional certification standards; At least 15% of mathematics and natural science courses meet the requirements of at least 15% of total credits in engineering education professional certification standards; At least 30% of the basic and professional courses in engineering majors, and at least 30% of the total credits in the engineering education professional certification standards; Engineering practice and graduation design (thesis) account for at least 25%, and meet the requirements of at least 20% of the total credits in the engineering education professional certification standards; The second class is at least 4 credits.

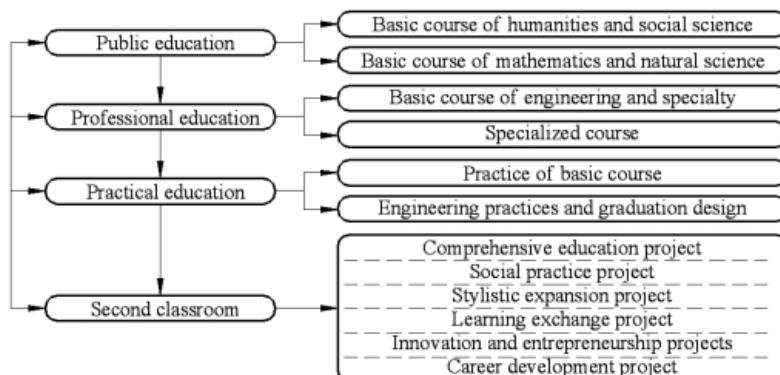


Figure 1. Course architecture diagram

The proportion of credits after the reform of the energy and power engineering curriculum system of our school is shown in Table I. [4]

TABLE I THE PROPORTION OF CREDITS AFTER THE REFORM OF THE ENERGY AND POWER ENGINEERING CURRICULUM SYSTEM

Course modules	Certification standard requirements(%)	After the reform of the curriculum system(%)
Humanities and Social Sciences	≥15	18.87
Mathematics and Natural Sciences	≥15	17.75
Engineering Foundation Courses and Professional Courses	≥30	33.55
Engineering Practice and Graduation Design (Thesis)	≥20	27.42
The Second Classroom	--	2.35

B. Professional course optimization

In combination with the school's energy and power engineering professional experience, each course of the undergraduate course must be connected to each other, so it is necessary to consider the matching and convergence between the courses. The learning process is mainly divided into three parts: The first is a basic course, including advanced mathematics, university physics, computers, etc. The second is the discipline foundation, including courses in structure and fluid mechanics, thermals and electricity; The third is a professional course, which mainly includes courses in the two directions of thermal power and energy comprehensive utilization. The entire curriculum is divided into three lines: The first is fluid and thermal related courses such as fluid mechanics, engineering thermodynamics, heat transfer, combustion, etc. The second is structural mechanics, including theoretical mechanics, material mechanics, etc. The third is a course in computer language. Therefore, in the semester of arranging each course, it is necessary to consider the connection problem of the above courses, and finally develop a reasonable teaching plan for energy and power engineering[4].

In the process of talent revision, the professional courses have been rationally optimized and integrated, and the original five professional theory courses have been optimized into four doors, except for the commonality of thermal instrumentation detection and control, heat exchanger principle and design. Outside the course, In addition to the professional development needs, the company has set up three professional directions: thermal engineering, refrigeration and low temperature engineering, and power engineering to meet the individual needs of society and student development. Each professional direction has three professional courses, such as the principle of thermal engineering. Three courses, such as steam turbine principle and thermal power plant, fully guarantee the professionalism. At the same time, through the addition of professional elective courses, such as industrial furnace thermal engineering and construction, power machinery manufacturing technology, power plant electrical system and other courses, students' knowledge is expanded to further improve students' scientific quality and professional quality.

At the same time, through the establishment of professional courses to cultivate students' awareness of innovation and entrepreneurship and internationalization capabilities, such as academic leaders and external enterprise engineering and technical personnel, professional introductions, frontier lectures, and introduction to professional safety to enhance students' humanistic qualities and engineering. Awareness, professional quality and innovative entrepreneurial awareness, the set of interdisciplinary courses or professional elective courses modules can meet and promote students' individualized learning and development.

C. Strengthening of practice

In the process of revising the talent training program, our school's energy and power engineering program focuses on strengthening the cultivation of students' practical ability, engineering quality and innovation ability, continuously optimizing and integrating professional practice links, and appropriately increasing the proportion of professional practice teaching links. The students' innovative practice ability provides a strong guarantee. The credits of the new talent training program practice teaching points accounted for about 27.4% of the total credits, an increase of 8 credits, nearly 5 percentage points, as shown in Table II. The heavy and orderly practical teaching links run through the whole process of talent cultivation, forming a layered and modularized practical teaching curriculum system, ensuring the gradual progress of all aspects of practical teaching, and realizing the organic combination of internal and external teaching and social practice in the process of personnel training. In the implementation process, we will focus on strengthening students' practical ability, engineering awareness, innovation ability and vocational skills[11,12].

TABLE II PROPORTION OF CREDITS FOR PRACTICAL TEACHING LINKS

Reform	Total credits	Practical credits	Percentage of practice
before	170	38.5	22.6%
after	170	46.5	27.4%

Through professional experiments, professional curriculum design, production internships, understanding of internships, and graduation design, the role of students in engineering quality education will be intensified, and the distance between students' professional knowledge and engineering production will be further narrowed, and students will strive to improve their engineering. Comprehensive quality, innovative ability and adaptability.

D. The development of scientific and technological innovation ability

In order to better improve the quality of engineering education and achieve the goal of engineering application-oriented innovative talent training, through the second classroom to create a multi-faceted scientific research practice training platform, complete the education and teaching links other than the courses and practical teaching links specified in the training program. Improve students' innovative ability and comprehensive practical quality.

Through the establishment of an innovation platform, students are encouraged to actively participate in extracurricular research activities, lectures, and social activities in community activities. Encourage students to actively participate in various science and technology competitions, such as fluid mechanics competition, energy conservation and emission reduction competitions, etc., arrange students to participate in the scientific research work of teachers, so that students can better master the theoretical knowledge of the profession and participate in the scientific research process. The ability to develop students'

research horizons.

Encourage students to participate in professional training and obtain relevant professional training certificates to effectively improve students' ability to solve practical problems in engineering. Establish a first-class classroom and the second classroom to closely integrate and promote the talent training system, guide students to participate in a variety of second-class classroom activities, create conditions for students' individuality development, characteristics and talents through various ways, and cultivate students' innovative thinking and practice. The ability, communication skills and teamwork spirit enable students to truly improve their practical ability and engineering quality, achieve the development of innovative ability, enhance employment competitiveness, and then be recognized by employers. Let students learn to think deeply, connect theory with practice, solve problems on their own, and raise awareness of teamwork [13].

E. Curriculum construction and teaching method reform

In order to better achieve the goal of talent training, adapt to the needs of the society, in the process of professional education, combined with the professional curriculum and practical curriculum system constructed by OBE concept, pay attention to the importance of curriculum construction in the process of talent cultivation.

Adhere to the standards and requirements of quality courses and excellent courses to improve relevant teaching resources, and actively create professional excellent courses and quality courses, effectively improve the quality of teaching, and drive the construction and development of the entire profession.

Strengthen the reform and practice of the teaching methods of the curriculum, actively reform the traditional teaching mode, and make full use of modern teaching methods, such as multimedia teaching, MOOC online teaching and virtual simulation teaching, and other innovative teaching methods and teaching methods to better activate the classroom atmosphere. Fully stimulate the mobilization of students' initiative and creativity, enable students to participate in teaching, strengthen classroom interaction, and improve teaching effectiveness. Innovative education teaching methods advocate heuristic, inquiry, discussion, and participatory teaching, and strive to explore diverse teaching methods [14-16].

At the same time, the profession gradually incorporates compulsory courses and professional elective courses into standardized management. Formulate reasonable and feasible syllabus and curriculum standards, and improve a series of high-quality teaching materials, teaching reference books and multimedia courseware. Actively improve the assessment methods of professional basic courses and professional courses, improve the test questions database, gradually implement unified propositions, separate test and test, and standardize the evaluation mechanism to ensure the quality of course construction.

IV. CONCLUSION

According to the standards and requirements of engineering education professional certification, the paper analyzes the problems existing in the energy and power engineering curriculum system of our school, and re-establishes professional training objectives and analytical training on the basis of fully listening to and adopting the opinions of industry experts and enterprises. Requirement, optimize the curriculum system, and develop a reasonable energy and power engineering professional teaching plan based on the various curriculums and interconnections. The newly revised curriculum system is based on the engineering education professional certification standards, and more prominent professional The characteristics of running a school closely combine the development of energy and power industry and the trend of talent demand, and strengthen the cultivation of students' professional ability and quality.

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